UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/666,541	09/19/2003	Katherina E. Babich	YOR920030191US1	5553

7590 03/11/2005

Paul D. Greeley, Esq.
Ohlandt, Greeley, Ruggiero & Perle, L.L.P.
10th Floor
One Landmark Square
Stamford, CT 06901-2682

EXAMINER	
WALKE, AMANDA C	
ART UNIT	PAPER NUMBER
1752	

DATE MAILED: 03/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/666,541	BABICH ET AL.	
	Examiner	Art Unit	
	Amanda C Walke	1752	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-40* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *19 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

GB

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-40 are rejected under 35 U.S.C. 102(b) as being anticipated by Angelopoulas et al (6,514,667).

Angelopoulas et al disclose a lithographic structure and method of fabrication and use thereof having a plurality of layers at least one of which is a an RCHX layer which comprises a material having structural formula R:C:H:X, wherein R is selected from the group consisting of Si, Ge, B, Sn, Fe, Ti and combinations thereof and wherein X is not present or is selected from the group consisting of one or more of O, N, S, and F and a layer of an energy active material. The RCHX layers are useful as hardmask layers, anti-reflection layers and hardmask anti-reflection layers. The RCHX layer can be vapor-deposited and patterned by patterning the energy active material and transferring the pattern to the RCHX layer. The present invention is directed to structures and methods useful for fabricating integrated circuits (IC), in particular structures having a plurality of layers. More particularly, the present invention is directed to tunable vapor deposited silicon, germanium, boron, tin, iron or, titanium and combinations thereof containing materials which function as antireflective coatings, as hardmasks and as combined antireflective coating/hardmasks for high resolution lithography. These materials and structures thereof can be applied to optical lithography (248 nm, 193 nm, 157, 126 nm), extreme ultraviolet lithography

(EUV), electron beam (e-beam) lithography, ion beam and x-ray lithography. To overcome some of the limitations of single layer resists, thin film imaging techniques have been developed including bilayer resists, trilayer resist systems and top surface imaging (TSI). In a bilayer structure, a thin resist containing Si functionality for etch resistance is coated on top of a thick polymer layer with suitable absorption at the exposing wavelength to act as a BARC and suitable etch resistance for substrate etch. Because of the thick resist/underlayer stack, this technique offer tremendous advantage for etch transfer. However, incorporation of Si moieties into the imaging resist structure is very challenging and can result in limited resolution and low performance of such resist systems. All of these thin film imaging techniques are more complex and costly than current single layer resist processes. It is desirable to develop a thin resist process which provides excellent lithographic performance and provides appropriate etch resistance for effective pattern transfer into the underlying substrate. In order to do this, improved BARCs are needed which provide better etch selectivity to resist than current organic BARCs. The BARCs need to (1) have appropriate optical properties to function as a suitable ARC at appropriate wavelength (2) provides good etch selectivity to resist (greater than 1:1) and (3) does not interact with the resist inducing residue, footing, undercut thereby limiting the overall lithographic performance of the resist. It is also desirable that the BARC also function as a suitable hard mask material for the underlayer oxide, nitride and Si etch. Herein, an improved resist process is disclosed encompassing a resist on top of a vapor deposited silicon, germanium, boron, tin, iron and titanium containing materials. These materials: (1) have appropriate optical properties at the given wavelength to function as an BARC (2) do not negatively interact with the resist creating residue, a foot, undercut as does the silicon oxy nitride BARC (3) provide improved etch

selectivity to resist as compared to conventional BARCs thus allowing a thinner resist to be used than that possible with conventional BARCs and (4) provide excellent etch selectivity to oxide/nitride thus allowing the BARC to also function as a hardmask. A broad aspect of the present invention is a resist structure comprising a resist on top of a vapor deposited RCHX film wherein R is selected from Si, Ge, B. Sn, Fe, Ti and mixtures of these elements and X is selected from O, N, S, F, and mixtures of these elements and X is optionally present in the film wherein the optical and chemical properties of the RCHX films are tuned to (1) provide suitable optical properties at the appropriate wavelength (248 nm, 193 nm, 157 nm, 126 nm and extreme ultraviolet radiation) to function as an ARC (2) not negatively interact with the resist inducing residue, footing or undercutting and (3) provides good etch selectivity to the resist. Typical resist structures consist of a resist on top of an antireflective coating ARC. The resist is exposed and developed and the image is then transferred through the ARC and then through the underlying oxide, nitride or silicon layers. Typical resist thickness is on the order of 5000A for the current state-of-the-art lithography process. During the ARC open, significant resist is lost as the etch selectivity between the resist and ARC is at best 1:1. As minimum features continues to decrease, it is desirable to thin the resist to attain the high resolution as well as improved process window (exposure and focus latitude). However, thinning the resist below 5000A poses etch problems. There will be insufficient resist to function as a etch mask for subsequent transfer etch into the oxide, nitride or Si layer. Compounding this problem is the fact that significant resist loss also occurs during the ARC open. To circumvent this problem, herein we disclose an improved resist structure consisting of a resist on top an improved vapor deposited ARC. This ARC provides significantly better etch selectivity to resist (>1:1), does not interact with the resist

in a negative fashion inducing footing, undercutting or residue as is characteristic of silicon oxy nitride ARC. In addition the optical properties of the vapor deposited ARC can be tuned by variations in the deposition process. Furthermore, the optical properties can also be tuned within the film thickness thereby forming a graded ARC. Lastly, the vapor deposited ARC can also function as a hardmask as it provides good etch selectivity to oxide, nitride and Si for etch transfer into the oxide, nitride and Si. Because of the improved etch selectivity to resist, it is now possible to thin the resist to below 5000A. It is also possible for the vapor deposited material to function as a combined ARC-hardmask. Given the teachings of the reference, the instant claims are anticipated.

Conclusion

3. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Paton et al (6,787,864), Wang et al (6,730,576), Grill et al (6,768,200), Todd et al (6,821,825), Horak et al (6,713,835), Chakravrti et al (6,500,772), Banerjee et al (6,320,202), and Mitchnick et al (6,045,650) are cited for their teachings of similar materials and methods.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Amanda C Walke whose telephone number is 571-272-1337. The examiner can normally be reached on M-R 5:30-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia Kelly can be reached on 571-272-1526. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Amanda C Walke
Examiner
Art Unit 1752

ACW
March 7, 2005